

**DISCOVERY, ABUNDANCE, AND DISTRIBUTION OF THE EXOTIC APPLE
TORTRIX, *ARCHIPS FUSCOCUPREANUS* WALSINGHAM (LEPIDOPTERA:
TORTRICIDAE), IN THE NORTHEASTERN UNITED STATES**

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Abstract.—The apple tortrix, *Archips fuscocupreanus* Walsingham, has infested unsprayed apple, *Malus domestica* Borkhausen, at Hamden, New Haven Co., Connecticut, since at least 1982. Adults reared in 1982 represent the first North American records of this Oriental pest of fruit trees. Among 10 tortricids on unsprayed apple trees at Hamden, the apple tortrix rated fourth in abundance, comprising 8.6% of 255 larvae sampled in May 1997. To determine the geographic range of the apple tortrix, pheromone-baited wing traps were placed in unsprayed trees of apple or crab-apple, *Malus* spp., at 30 sites in Connecticut and at one or more sites in 25 other states in the eastern United States. In addition, tortricid adults reared from larvae collected on rosaceous plants in southern New England were examined. Based on our evidence from the eastern United States, the apple tortrix currently is known from four counties in Connecticut and one in Massachusetts. All of the locations are within 15 km of the Atlantic Ocean. Pheromone traps used in the survey also attracted the red-banded leafroller, *Argyrotaenia velutinana* (Walker), and *Plitheochroa riscana* (Kearfott), which, like the apple tortrix, are species of Tortricinae. The apple tortrix may be spread to new areas by the transport of nursery plants infested with the inconspicuous black egg masses.

Key Words: abundance, apple, apple tortrix, *Archips fuscocupreanus*, distribution, exotic pest, Tortricidae

Immigrant insects have had a profound and lasting effect upon agriculture in North America and elsewhere. Every year new pests are detected, and researchers begin to explore methods to limit their impact. The codling moth, *Cydia pomonella* (Linnaeus), and the Oriental fruit moth, *Grapholita molesta* (Busck), are notorious exotic tortricids that have increased the cost of managing fruit orchards in North America. These are only two examples of 31 exotic tortricid species known to be established in North America (Miller 1997). In this report, we increase the total to 32 by documenting that

the apple tortrix, *Archips fuscocupreanus* Walsingham, is present in the northeastern United States where it may pose a new threat to the fruit and nursery industries.

The apple tortrix is a pest of fruit and ornamental trees in Japan and Korea (Oku 1967, Yasuda 1975, Sekita et al. 1994). Oku (1967) has reported that the larvae have a broad host range, attacking plants in more than 10 families. Oku (1967, 1970), Yasuda (1975), Sekita and Yamada (1990), and others have presented details of the life history. In Japan, the apple tortrix is univoltine, overwintering as an egg in a black egg

mass. In spring, larvae hatch and feed on leaves, and later on flowers and fruits. Larvae may use all of these plant parts to construct their shelters. The distinctive last-instar larvae have an orange or brownish orange head. Adults emerge during early summer, and after mating females lay eggs in masses on trunks and branches of woody plants. According to Oku (1967), adults fly from late June to early August. Sekita and Yamada (1990) have reported a shorter flight period of mid-June to early July.

Here we document that *A. fuscocupreanus* has been in the United States since at least 1982. In addition, we give details of its relative abundance at the site of its first collection and describe its distribution in the eastern United States.

MATERIALS AND METHODS

Identification.—Adult males were identified by comparing the pattern and coloration of forewings, the costal fold of the forewings, and genitalia to descriptions and illustrations in the Japanese literature (Yasuda 1975) and to specimens examined at the Smithsonian Institution. *Archips fuscocupreanus* and the similar European (or filbert) leafroller, *A. rosanus* (Linnaeus), may inhabit plants at the same locality; however, males of these two can be separated easily by the size of the male costal fold (Fig. 1). Voucher specimens of adults are deposited at The Connecticut Agricultural Experiment Station, New Haven, at the National Museum of Natural History, Smithsonian Institution, Washington, D.C., and at The Natural History Museum, London. The first specimens from North America are deposited at The Connecticut Agricultural Experiment Station.

Relative abundance.—On 21 May 1997, the relative abundance of tortricid larvae in an orchard of unsprayed apple trees, *Malus domestica* Borkhausen, at Lockwood Farm, Hamden, New Haven Co., Connecticut, was determined by sampling 10 randomly selected trees for 10 min/tree. Larvae were confined singly in translucent plastic por-

tion cups (Comet Products, Chelmsford, MA) with apple foliage, and were reared to adults to confirm their identity. The cups (28 ml) were placed in plastic trays (Bio-Serv, Frenchtown, NJ) in clear plastic boxes (23 × 31 × 10.5-cm [high]) with 25 ml of water in the bottom to increase humidity. Foliage was replaced twice weekly. Larvae were kept in a room adjusted to $21 \pm 1^\circ\text{C}$ and a 15L:9D photoperiod.

Distribution.—Distributional records for *A. fuscocupreanus* are based on adults reared from larvae or captured in pheromone traps. In 1997, larvae were sampled at one site in Massachusetts and two in Connecticut, and reared to adults as described above. Additional records of reared *A. fuscocupreanus* were obtained by identifying tortricid adults in the insect collection at The Connecticut Agricultural Experiment Station.

In 1997, pheromone-baited Pherocon IC wing traps (Trécé, Inc., Salinas, CA) were monitored by the senior author in Connecticut and by cooperators in 25 other states in the eastern United States (Fig. 2). Each trap was baited with a gray rubber sleeve stopper (#1888, West Co., Lionville, PA) impregnated with 0.8 mg (Z)-11-tetradecenyl acetate (Albany International, Needham Heights, MA) and 0.2 mg (E)-11-tetradecenyl acetate (Pherobank Wageningen, Wageningen, The Netherlands), which were dissolved in hexane before dispensing them onto each stopper (100 μl /stopper). Ando et al. (1981) found that this blend of chemicals attracted males of the apple tortrix in Japan. Lures were suspended about 2–3 cm below the top of the traps in plastic lure holders (USDA holders used in the National APHIS, PPQ Exotic Pest Detection Program). A single trap was used at each trapping location except Hamden where four traps were deployed. Each trap was hung at a height of 1.5–2 m above ground in an unsprayed tree of apple or crab-apple, *Malus* spp., about 4–6 weeks after bloom. Bloom across the eastern United States was estimated by survey participants. Traps in

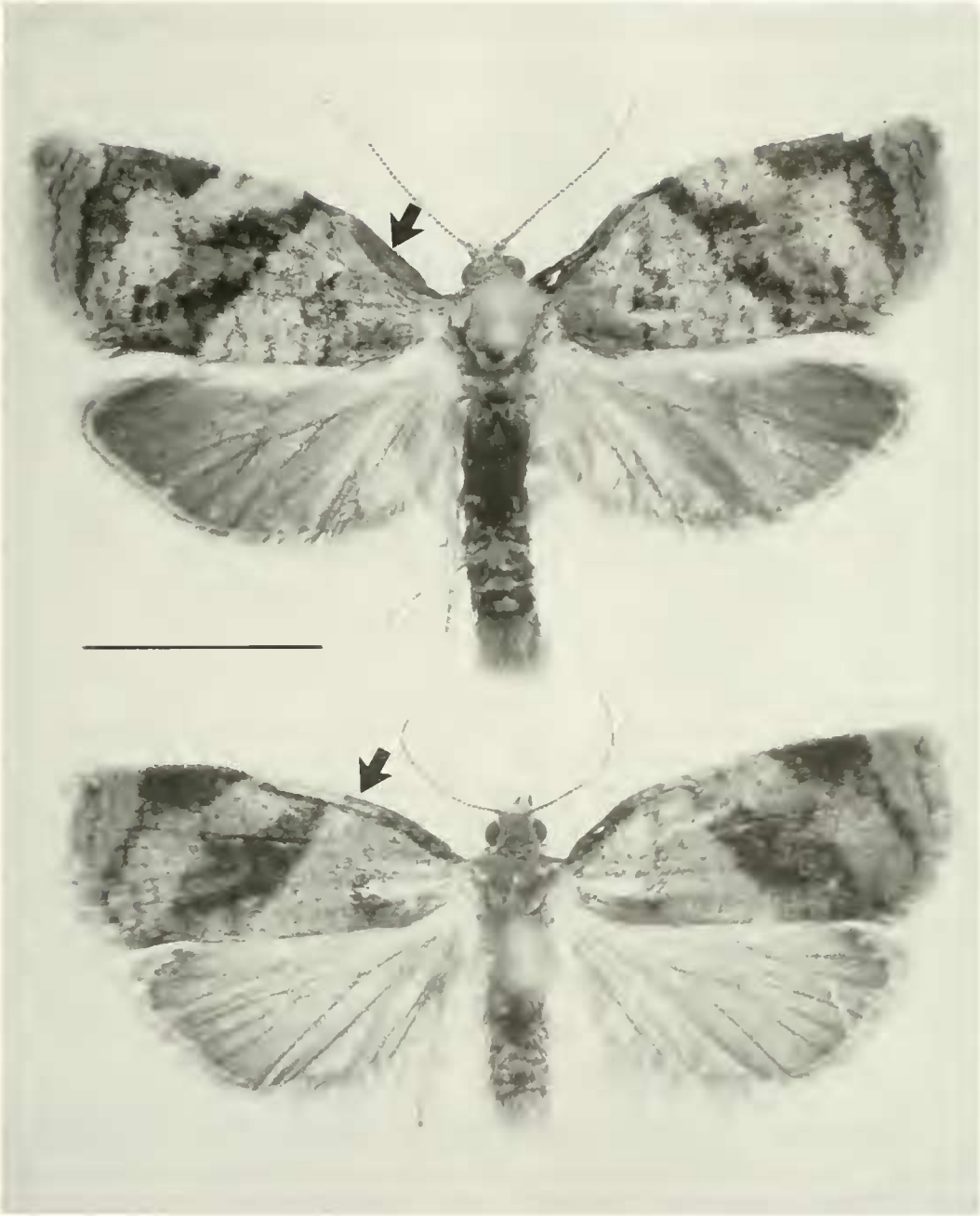


Fig. 1. Adult males of the apple tortrix, *Archips fuscocupreanus* (top), and the European leafroller, *A. rosanus* (bottom). Arrows point to the costal fold. The costal fold of *A. fuscocupreanus* is thick and extends about one-third of the length of the costal margin of the forewing, whereas that of *A. rosanus* is comparatively thin and extends about one-half of the length of the costal margin. Horizontal line = 5 mm.



Fig. 2. Location of pheromone-baited wing traps operated for 4 weeks in June and July 1997 to detect the apple tortrix, *Archips fuscocupreanus*. Each solid circle indicates a county where one or more pheromone traps were placed.

Connecticut and northward were deployed after the first catch on the night of 19–20 June in the traps at Hamden. Unless otherwise stated, all traps remained in the field for 4 weeks, and bottoms were changed after 2 weeks. To prevent the accidental introduction of insects into new areas, trap

bottoms were frozen before they were shipped to Connecticut to be examined.

RESULTS AND DISCUSSION

Discovery and relative abundance at Hamden.—Based on two adults reared from larvae collected on unsprayed apple trees,

Table 1. Relative abundance (% total) of tortricid larvae sampled on 10 unsprayed apple trees at Lockwood Farm, Hamden, Connecticut, on 21 May 1997.

Species	No. larvae $\pm$ SE/tree	% Total larvae
<i>Archips fuscocupreanus</i> Walsingham	2.2 $\pm$ 1.7	8.6
<i>A. griseus</i> (Robinson)	0.3 $\pm$ 0.2	1.2
<i>Choristoneura rosaceana</i> (Harris)	0.2 $\pm$ 0.2	0.8
<i>Hedya chionosema</i> (Zeller)	0.4 $\pm$ 0.2	1.6
<i>H. dimidialba</i> (Retzius) ¹	0.9 $\pm$ 0.3	3.5
<i>Olethreutes malana</i> (Fernald)	2.6 $\pm$ 0.5	10.2
<i>Pandemis limitata</i> (Robinson)	0.1 $\pm$ 0.1	0.4
<i>Pseudexentera mali</i> Freeman	4.3 $\pm$ 1.0	16.9
<i>Spilonota ocellana</i> (Denis & Schiffermüller)	14.4 $\pm$ 0.5	56.5
Unknown tortricine	0.1 $\pm$ 0.1	0.4
Total larvae	255	

¹ Senior synonym of *H. nubiferana* (Haworth)

the apple tortrix has been present at Lockwood Farm, Hamden, New Haven Co., Connecticut, since at least 1982. These moths are the first North American specimens of this exotic tortricid. Additional adults were reared from larvae collected on apple at Hamden in 1983, 1984, and 1994–97.

On 21 May 1997, ten species of tortricid larvae were collected on apple trees at Hamden (Table 1). Among the 10 species, the apple tortrix rated fourth in abundance. This exotic tortrix is now common at this Hamden site where it was first found.

Distribution.—The apple tortrix was identified among tortricid adults reared from larvae, captured in pheromone traps, or both in four counties in Connecticut and in one county in Massachusetts (Fig. 3). All of these counties border the Atlantic Ocean, and every population of the apple tortrix is located within 15 km of the ocean. We suspect that additional populations will be found in other coastal counties between Massachusetts and northern New Jersey. The apple tortrix also is established in six coastal counties in the state of Washington (E. LaGasa, personal communication).

Pheromone traps captured not only *Archips fuscocupreanus*, but also the red-banded leafroller, *Argyrotaenia velutinana* (Walker), and *Phtheochroa riscana* (Kearfott) (Table 2), both of which easily can be

distinguished from the apple tortrix. No males of *Archips rosanus* were captured in pheromone traps. In Connecticut, the number of trapped adults ranged from 0–105 for *Archips fuscocupreanus*, 0–59 for *Argyrotaenia velutinana*, and 0–17 for *P. riscana*. *Archips fuscocupreanus* was captured at 6/28 (21.4%) sites, *Argyrotaenia velutinana* at 26/28 (92.9%) sites, and *P. riscana* at 22/28 (78.6%) sites. Males of the red-banded leafroller apparently entered the traps because the lures had two chemicals that are major components of the female sex pheromone (Roelofs et al. 1975).

Based on this survey, the apple tortrix has a limited distribution in the northeastern United States. Its ability to migrate and colonize new areas is unknown. The preference of females to oviposit on the bark of trees, however, raises the concern that the movement of nursery stock may spread the apple tortrix to new areas. The long-term impact of this exotic moth on cultivated and wild trees is unknown, but, based on its damage and host range in Japan (Oku 1967, 1970; Sekita et al. 1994), it is likely to attain pest status in North America. If the apple tortrix achieves pest status, it could disrupt ongoing and developing IPM programs in North American fruit orchards.

DISTRIBUTIONAL DATA

Localities are given by state, county, and nearest town. Multiple towns listed after

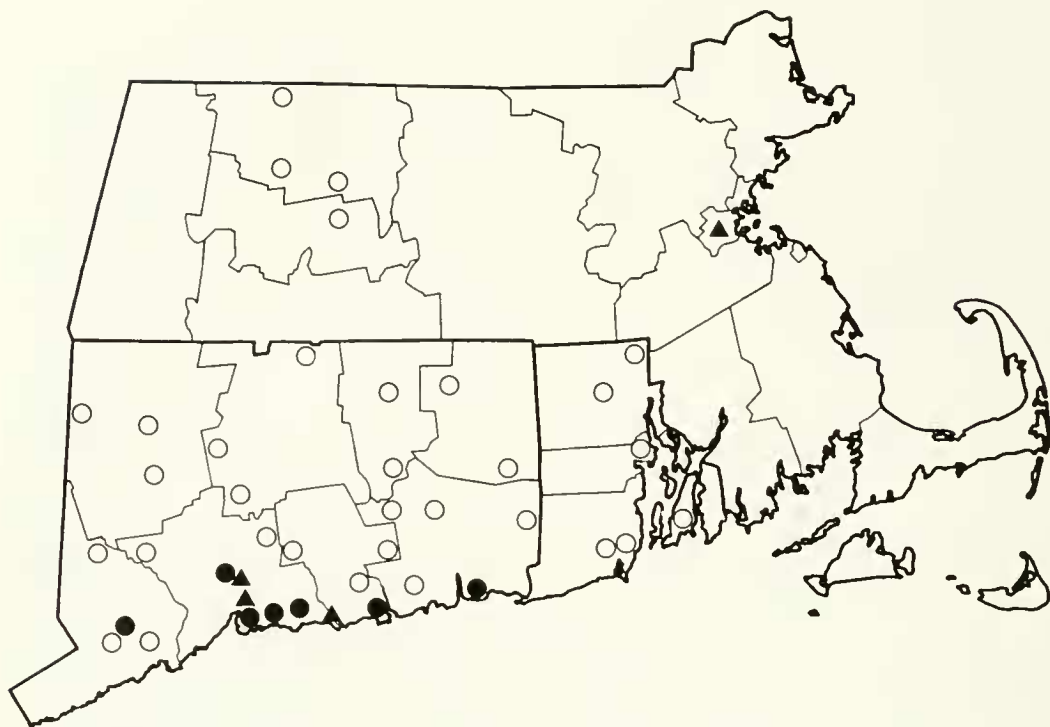


Fig. 3. Distribution of the apple tortrix, *Archips fuscocupreanus*, in southern New England. Solid circles show where males were captured in pheromone traps; hollow circles indicate where males were not captured in traps. Solid triangles show where larvae were collected and reared to adults.

some counties represent different sites. If two localities in one town were surveyed, additional information is given. Records of reared moths include the host plant and the date of larval collection; only rearing records before 1995 and the first records for a locality are reported here. For sites with the apple tortrix, the number of moths captured in pheromone traps or reared is enclosed in parentheses.

Rearing records.—CONNECTICUT: New Haven Co., Hamden, *Malus domestica*, 20 May 1982 (2), late May 1983 (1), 4 June 1983 (1), 21 May 1984 (18), 27 May 1994 (3); Madison, *Rosa rugosa* Thunberg, 2 June 1997 (2); New Haven, East Rock Park, *Prunus serotina* Ehrhart, 8 June 1983 (3), 8 June 1984 (4). MASSACHUSETTS: Suffolk Co., Jamaica Plain, *Prunus salicina* Lindley, 4 June 1997 (2).

Positive trapping records.—CONNECTICUT: New London Co., Groton, 26 June–

1 July (2). See Table 2 for the six additional Connecticut localities where moths were captured in pheromone traps.

Negative trapping records.—ARKANSAS: Benton Co., Rogers. CONNECTICUT: see Table 2. DELAWARE: Kent Co., Rising Sun; New Castle Co., Newark. GEORGIA: Union Co., Blairsville. ILLINOIS: Champaign Co., Urbana. INDIANA: La Porte Co., Waterford; Porter Co., Washington; Tippecanoe Co., West Lafayette. KENTUCKY: Boone Co., Hebron; Woodford Co., Pinckard, Pisgah. MAINE: Kennebec Co., Winthrop. MARYLAND: Montgomery Co., Burtonsville. MASSACHUSETTS: Franklin Co., Colrain, Conway, Leverett; Hampshire Co., Amherst. MICHIGAN: Grand Traverse Co., Williamsburg; Leelanau Co., Suttons Bay; Manistee Co., Onkama; Mason Co., Ludington; Oakland Co., Clarkston; Oceana Co., Shelby. MISSISSIPPI: Oktibbeha Co.,

Table 2. Number of the three most abundant Tortricidae (Tortricinae) caught in pheromone traps in Connecticut during 4 weeks in June and July 1997. Abbreviations: AT = apple tortrix, *Archips fuscocupreanus*; RBLR = red-banded leafroller, *Argyrotaenia velutinana*, and PR = *Phitheochroa riscana*.

County	Town	Trapping dates	Number of moths ¹		
			AT	RBLR	PR
Fairfield	Brookfield	25 June–22 July	0	2	2
	Easton ²	25 June–22 July	6	16	1
	Easton ³	25 June–22 July	0	46	11
	Trumbull	25 June–22 July	0	22	2
Hartford	Burlington	25 June–22 July	0	3	0
	Southington	23 June–20 July	0	26	2
	Suffield	25 June–22 July	0	5	3
Litchfield	Goshen	25 June–22 July	0	1	0
	Morris	25 June–22 July	0	3	2
	Sharon	25 June–22 July	0	13	0
Middlesex	Deep River	23 June–20 July	0	14	1
	Durham	25 June–22 July	0	44	1
	East Haddam	23 June–20 July	0	22	15
	Old Saybrook	23 June–20 July	14	5	5
New Haven	Branford	23 June–20 July	10	33	3
	Guilford	23 June–20 July	2	15	2
	Hamden ³	19 June–16 July	75	— ⁴	— ⁴
	Meriden	23 June–20 July	0	36	1
	New Haven	27 June–24 July	105	0	10
	Southbury	25 June–22 July	0	31	1
New London	Bozrah	23 June–20 July	0	50	6
	Colchester	23 June–20 July	0	9	8
	East Lyme	23 June–20 July	0	59	17
	Voluntown	23 June–20 July	0	4	0
Tolland	Columbia	23 June–20 July	0	26	13
	Tolland	23 June–20 July	0	0	0
Windham	Eastford	23 June–20 July	0	2	0
	Plainfield	23 June–20 July	0	55	3

¹ Four pheromone traps were operated at Hamden, and one at all other sites.
² Orchard Lane, Slady Orchard.
³ State Road 58, Aspectuck Valley Orchard.
⁴ Species was present but not counted.

Mississippi State. MISSOURI: Howard Co., New Franklin; Wright Co., Mt. Grove. NEW HAMPSHIRE: Cheshire Co., Walpole; Hillsborough Co., Lyndeborough; Rockingham Co., Deerfield, Londonderry. NEW JERSEY: Cumberland Co., Deerfield. NEW YORK: Columbia Co., Taghkanic; Dutchess Co., LaGrange; Monroe Co., Brockport; Niagara Co., Appleton; Ontario Co., Geneva; Orleans Co., Albion; Rensselaer Co., Castleton-on-Hudson; Wayne Co., Williamson, Wolcott. NORTH CAROLINA: Henderson Co., Hendersonville; Wake Co., Raleigh. OHIO: Hancock Co., Fostoria; Seneco Co., New Riegel. PENNSYLVANIA: Adams Co., Fairfield; Centre Co., State College; Perry Co., New Bloomfield. RHODE ISLAND: Kent Co., Warwick; Newport Co., Middletown; Providence Co., Cumberland, Greenville; Washington Co., Kingston, East Farm, Mark Glen Court. SOUTH CAROLINA: Charleston Co., Mt. Pleasant; Colleton Co., Hendersonville; Greenville Co., Simpsonville; Horry Co., Conway; Lexington Co., West Columbia; Marlboro Co., Bennettsville. TENNESSEE: Dyer Co., Dyersburg; Fayette Co., Somerville; Grundy Co., Tracy City; Haywood Co., Stanton; Jefferson Co., Strawberry Plains; Knox Co., Knoxville;

Madison Co., Jackson; Obion Co., Shawtown; Williamson Co., Nolensville. VERMONT: Addison Co., West Cornwall; Chittenden Co., Burlington; Windham Co., Putney. VIRGINIA: Augusta Co., Steeles Tavern; Craig Co., New Castle. WEST VIRGINIA: Jefferson Co., Bardane, Kearneysville; Nicholas Co., Summersville. WISCONSIN: Dane Co., Madison; Milwaukee Co., Milwaukee.

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